



Enhancing Students' Learning Outcomes Through Simulator Program: A Case Study of using Swansoft CNC Simulator Software in Vocational Education

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Abstract. This research aim to describe the student's learning outcome enhancement on using Swansoft simulator software to explain non-conventional CNC technology topic in the vocational high schools. Skills for vocational students are absolutely mandatory. CNC become a complex topic to be learned as mechanical student and also offer higher risk to use. Hence, we need a simulator to minimize this risk and reduce its complexity. Swansoft is completely to overcome this issue. Qualitative methods were used to observe the learning outcome. Data was collected by observation and non-interactive interview. Then, it was analyzed in 3 step, such: data reduction, data display, and data conclusion. From the data, it found that student has escalation of learning consciousness. Student tend to more aware before using the real machine. In mentality, student tend more ready and carefully. This research offer a novel of student's learning characteristic in using simulator soft-ware to support complex machine understanding. It could be improvement novelty for further researcher. Furthermore, this software help teacher to teach a complex topic with familiar interface in real condition. Where it hard to keep our focus on using high risk machine, a simulator software help more to minimize prospective operator in danger and having good quality learning outcome.

KEYWORDS: STUDENT'S LEARNING, SWANSOFT SIMULATOR, CNC TECHNOLOGY.

INTRODUCTION

In modern era, using a technology as learning equipment is primary needed. Currently, competitive era has force industry to invest new modern technology [1,2]. As well as education institution should follow this trend, so their graduate will easy to adapt [3-5]. No exception, that in teaching of non-conventional CNC technology machine topic in vocational school need this.

Currently in manufacturing industry, CNC (Computer Numerical Control) become one of the high risk machine, which need specialized skills [6-8]. CNC is also known as non-conventional machine tool which learned by mechanical engineering student at vocational schools. In the manufacturing industry, this tool use for creating additional metal product or object in various shape and dimension. This machine reliable to produce metal design in automatic control. Many industry has this own machine, as primary machine needed. It has large demand in industry. However, only skillful person could operate this tools. To operate this machine need to know all the feature, especially the G-Code as programming techniques which make this machine as complex one. The existence of a simulator helps prospective operators understand the features, of course with low risk [9,10].

Research on the use of simulator has received many attention to reduce workplace accidents at the school in recent years [11]. This media offer effectively learning outcome for student in any grade. Murdadi [12], success to

use a simulator to increasing student scores above the minimum completeness criteria. This era, force teacher to use appropriate media technology to support their learning activity. Tools media help to stimulants student learn more in more major [13]. One of the tools simulator which offer convenience for CNC, called with Swansoft software. It developed by Swansoft Technology Company, which offers an open source simulation environment for CNC machines that includes setup, adjustment, measurement, and fault finding. Using this software able to make lessons environment positively, easier to use, and affects students' competency [14].

Learning outcome could be measure in various way [15]. One of the best idea to know a success of learning outcome by measure student's learning consciousness. This research aim to describe student's outcome enhancement in learning of CNC topic by using Swansoft software simulator. Its outcome could be improvement novelty for further researcher as discuss in this paper.

METHOD

To describe the findings of student's phenomena during learning, qualitative methods were used in this article [16]. Data collection was taken by using deep observation and non-interactive interview during the class. Every phenomenon which happen, written as findings from a series of studies. Data was collected for 43 mechanical student in an active semester from a vocational high school in Surakarta, Indonesia. Deep analysis was taken by using Miles and Huberman method, consist of data reduction, data display and data conclusion [17]. All the process was taken until found its conclusion as a novel finding of this research. Data conclusion was gained to described how far student's outcome enhancement in learning of CNC topic by using Swansoft software simulator. It would be explained point of view where improvement novelty offer of this paper and how this article help for further researcher discuss related topic.

RESULT AND DISCUSSION

A research has been taken in a high vocational school to understand student learning outcome during using Swansoft software simulation. Students are given material for the manufacturing and milling processes using CNC machines. At the beginning of the course, students will learn about the fundamentals of CNC, as well as the functions of buttons, codes, and how to operate a CNC machine using a Swansoft simulator. Turn on the machine, set the tool, rotate the spindle, enter the program code, edit the program, run the program, save the program, and turn off the CNC machine should be taken as basic competencies. Figure 1 show student's learning activity during using Swansoft.

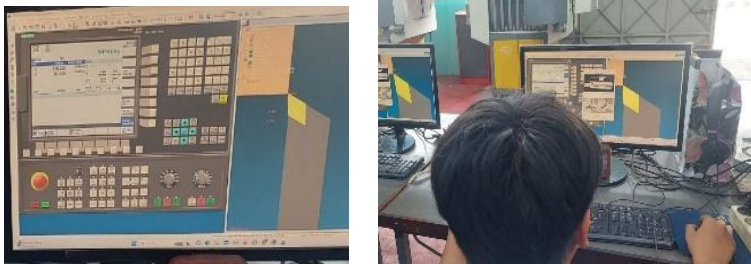


FIGURE 1. Student's activity on using swansoft simulator software

During the process of learning was found any kind of phenomenon as evidence to describe the learning outcome. At the end of the semester, students submit evaluations to offer formative and summative comments on the course and its outcomes. While, observation was taken during course and in the end of the course. The most effective student-centered teachers use specific interventions, such as producing organized media, to facilitate knowledge and empower students. Effective teachers also collect, analyze, and apply data to assess student abilities and deficiencies, student learning, and the value of their education along the learning using simulator [18]. According to

observation data and non-interactive interview, the characteristics and outcome interpretation of the students in learning by using Swansoft simulator are shown in Table 1.

TABLE 1. Student's learning characteristic

Students Characteristic		Outcome Interpretation
Using Swansoft	Without Swansoft	
<ul style="list-style-type: none"> • Student tend more confident before using real machine 	<ul style="list-style-type: none"> • Student need more time to find their mentality to operate CNC, because its risk 	<ul style="list-style-type: none"> • Enhance self-confidence
<ul style="list-style-type: none"> • Student has been familiar with icon feature, it's closely to acquire the machine. The app has many machine type to retrieve. 	<ul style="list-style-type: none"> • Student easy to understand the feature, but hard to synchronize if it change to different type of machine 	<ul style="list-style-type: none"> • Enhance time to synchronize
<ul style="list-style-type: none"> • Free and no limit access for trial and error learning 	<ul style="list-style-type: none"> • Error affect to peripheral and pose an danger potential 	<ul style="list-style-type: none"> • Reduce risk of danger
<ul style="list-style-type: none"> • Fast to stimulant logic ability 	<ul style="list-style-type: none"> • Logic ability should be ready first, before operate machine 	<ul style="list-style-type: none"> • Stimulant logic ability
<ul style="list-style-type: none"> • Student score higher in average 	<ul style="list-style-type: none"> • Students score depend on logic ability, student with good logic and mentality tend to has higher score, but medium in average 	<ul style="list-style-type: none"> • Enhance student's understanding
<ul style="list-style-type: none"> • Take student consciousness at various machine type. 	<ul style="list-style-type: none"> • Take consciousness at the part of using machine for various product could be produce 	<ul style="list-style-type: none"> • Enhance consciousness

Before using simulator students tend hesitant and slow in operating the machine. It causes by the risk of the machine, affect to their performance to be more carefully. Everyone need to adapt first, so they get their confidence. Theory always support the practice, however not at all could be easy correlate to practice feature. One of the student AZ was giving his opinion bellow:

- [Researcher] : *What is your opinion using Swansoft simulator before practicing the real one?*
 [AZ] : *This software is pretty useful. All the feature inside look same with the real one.*
 Answer] : *Easy for me to understand and do practice without hesitate. If wanna make a project, it better for me to try it in this software first. So I can minimize the mistake.*
- [Researcher] : *Do you think by using swansoft increase your performance than before?*
 [AZ] : *Yes, I do.*
 Answer]

From the conversation, it's known that AZ tend to be more confident and able to minimize the potential risk. As well as Swansoft feature is same with machine feature, it could gain quick thinking skills of the students. In the real machine, if error happen, it would affect to high cost of maintenance. And not all of the payment will be guarantee by the teacher, it is also considered of student. This another thing which make student afraid by using this machine. This software help them to accommodate this condition. Another respondent was giving her opinion bellow:

- [Researcher] : *What is your opinion using Swansoft simulator before practicing the real one?*
 [BA Answer] : *As well as important to practice in carefully, this software help me to make a trial and error G-code. It effective for me before using the real one. I think it is good idea to use this software, however I need a laptop to use it. Even I don't have one, I can use school's facilities.*
- [Researcher] : *Do you think by using swansoft increase your performance than before?*

[BA Answer] : *Yes, I do. I can understand G-Code better using this software. My exam score also increase.*

BA take advantage of using Swansoft to understand G-Code principle. The main of operating CNC Machine is using G-Code. Mechanical system will not work properly without fix G-Code. This simulator has access to predict the right code and simulate its result. Students also able to make a strategy to change its code for the efficient one. This simulator also help BA to increase her exam score. Its mean that, he is more understand about this topic after using the software simulator in consistently.

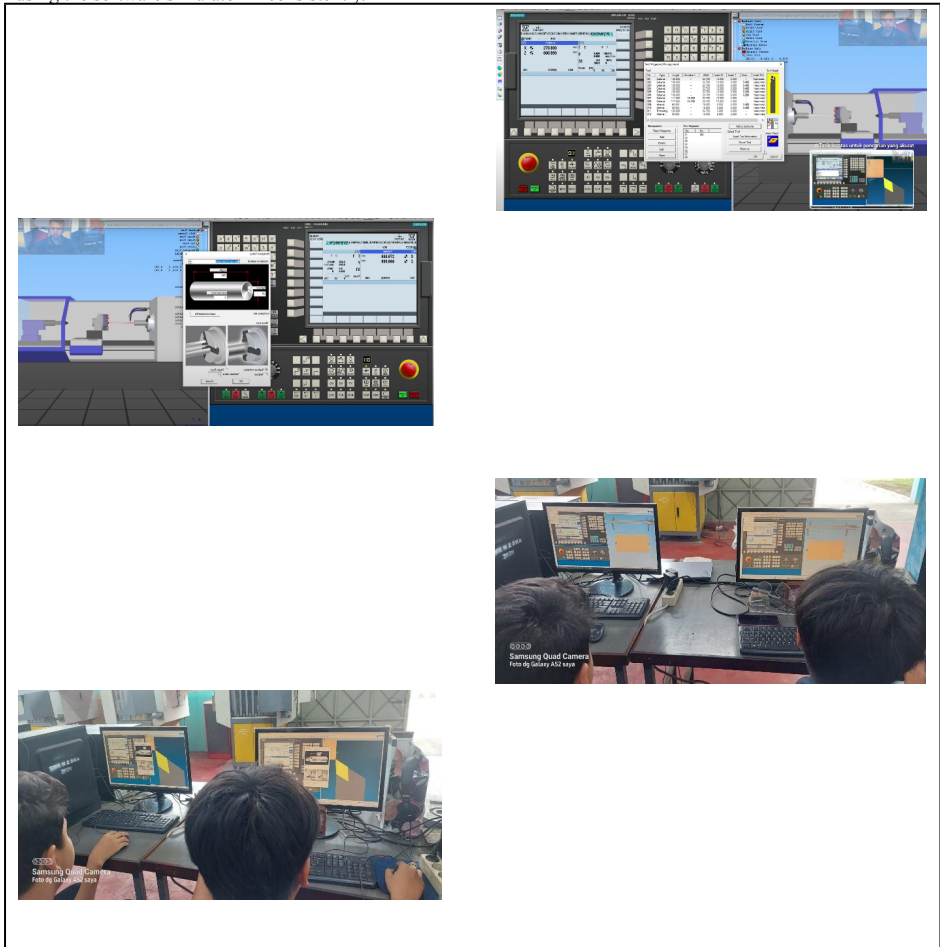




FIGURE 2. Student using swansoft to trial and error G-Code before using the real CNC machine.

Figure 2. Show us how student use Swansoft to learn G-code as a trial and error learning media. It fact that student has their own characteristic and flexibility while learning in the class [13-16]. There are many factor which affect their preference. It should be highlighted, if in this research found that student's logic ability and media technology preferences has big influence their learning outcome. According to Bennet, logic ability has important role to make a better learning outcome [19,20]. Table 1 show us that, each students has their own characteristic which correlate to their dominant learning outcome. Some students prefer to use it to test their G-Code, and some of them use it to be familiar with each feature available. However, all student stated this software make them more confident to use it.

There is a significant difference in the use of software. Student with good logic ability, do not need it much. Because they easy to take balance every feature in machine without any simulation. However, by using the simulator students in average has more time to try so they will learn from each error mistake. Student tend to be more confident, having enough time to repeat, even at home. This process may eventually enhance skill level. According to [12], it's effective process to increase learning outcome of the student. In the future, there will many simulator technology which consist of real feature not only for education, but also for any industry context.

Refer to the analysis offer, it shown that vocational student tend to be more capable to operate CNC machine by using Swansoft software before. This software suitable to reduce high risk in using complex machine. By using this simulator they could enhance various ability such as: self-confidence, time to synchronize, less risk, stimulant logic ability and understanding, and also student consciousness. All this ability should be important to be professional operator candidate in workplace. One of student's characteristic in using high risk machine, tend to be slow and full of afraid to think its risk effect. Simulator become all in solution to reduce high risk fear.

This research offer a novel of student's learning outcome characteristic in using simulator software to support complex machine understanding. It could be improvement novelty for further researcher, while it is important to use a simulator before running a high-risk machine. This software help teacher to teach a complex topic with familiar interface in real condition. Furthermore, where it hard to keep our focus on using high risk machine, a simulator software help more to minimize prospective operator in danger and having good quality learning outcome

CONCLUSION

According to the result, it could be stated that learning outcome for non-conventional CNC machine learning topic could be increased by using a Swansoft software simulator. Simulator media has many advantage to use in vocational schools, especially to reduce any risk for high technology of metal cutting. Case study which has been taken offer finding for further research where using of simulator could enhance various ability such as: self-confidence, time to synchronize, less risk, stimulant logic ability and understanding, and also student consciousness. This research offer a novel of student's learning characteristic in using simulator software to support complex machine understanding. It could be improvement novelty for further researcher. Furthermore, we need to develop any media technology in order to adapt industry inquiries.

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